DOCUMENT RESUME

ED 391 664 SE 057 612

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TITLE Using Portfolios To Assess Teacher Development in Elementary Mathematics Teacher Preparation.
PUB DATE Oct 95
NOTE 18p.; Paper presented at the Annual Meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education (17th, Columbus, OH, October 21-24, 1995).
PUB TYPE Speeches/Conference Papers (150) -- Reports - Descriptive (141)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Education Majors; Elementary Education; Higher Education; *Mathematics Instruction; *Methods Courses; Portfolio Assessment; Portfolios (Background Materials); *Preservice Teacher Education; *Student Evaluation

ABSTRACT

Relying on only one method of assessment does not necessarily yield an accurate picture of student achievement. This paper discusses aspects of designing, implementing, and evaluating portfolios in a mathematics methods classroom; describes how the use of portfolios has influenced teaching practice; and contains excerpts from student portfolios. The paper also includes an excerpt from the portfolio description sheet, the grading criteria sheet, an excerpt from the syllabus, the midterm portfolio review grading rubric, an example of a video critique sheet, an activity recording sheet, and a group activity rating sheet. (MKR)

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# USING PORTFOLIOS TO ASSESS TEACHER DEVELOPMENT IN ELEMENTARY MATHEMATICS TEACHER PREPARATION

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A paper presented at the 1995 Meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education, Columbus, Ohio.

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# USING PORTFOLIOS TO ASSESS TEACHER DEVELOPMENT IN ELEMENTARY MATHEMATICS TEACHER PREPARATION

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Relying on only one method of assessment does not necessarily yield an accurate picture of student achievement. Thus there is a need to provide students alternative ways to demonstrate their understanding of course content. Portfolios have the potential to engage students in decision making, provide students a voice in their assessment, enhance their metacognitive awareness, and encourage students to take responsibility for their own learning (Gilman & Rafferty, 1995).

In an effort to learn more about portfolio assessment and to demonstrate alternative assessment techniques to future elementary mathematics teachers, I have begun to incorporate portfolio assessment in my mathematics methods course. My approach to portfolio assessment was informed by much of the current literature on portfolios (e.g. Gilman & Rafferty, 1995; Lambdin & Walker, 1994; Stenmark, 1991).

In the following sections, I (a) discuss aspects of designing, implementing, and evaluating portfolios in the mathematics methods classroom, (b) describe how my experiences in using portfolios have influenced my practice, and (c) share excerpts from student portfolios.

## Designing, Implementing, and Evaluating Portfolios

My preservice elementary mathematics students participate in midterm and final portfolio review conferences in lieu of written examinations. During those conferences, students present chosen pieces for their portfolios which demonstrate their understanding of course objectives and document their mathematics field experiences. They provide verbal and written rationale for each piece selected. In addition, students discuss their strengths and areas for improvement in mathematics teaching as a means of goal setting. Students are primarily responsible for driving the conversation while my role is to ask questions and provide comments. In addition, students are given varying degrees of freedom in developing rubrics for grading the portfolio.

The following is an excerpt from the assignment description sheet in which I outline the students' responsibilities for portfolio assessment.

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**Excerpt From Portfolio Description Sheet (Spring 1995)**

**Portfolio Reviews**

During the course of the semester, you will be asked to organize and reflect upon course content and the assignments completed by developing a portfolio both at the midterm and final points in the semester. The work included in the portfolio will be both representational (your revised, polished work) and developmental (drafts, revisions, feedback). The purpose of this assignment is for you to reflect upon all of your work and synthesizes it into a comprehensive representation of your knowledge about teaching and learning mathematics. A portfolio captures both the final product and the learning process, promoting growth and emphasizing quality work.

For the **midterm portfolio** (40 pts), you will provide pieces of your work from the first half of the semester which include:

1) two pieces that show growth/learning about mathematics/teaching mathematics
2) one piece that is representative of quality work
3) one piece that reflects your feelings/beliefs about mathematics/teaching mathematics
4) one piece that demonstrates the process of planning for the practicum
5) one piece that represents a quality lesson implemented in your practicum

**Each of the six pieces should be accompanied by a *typed rationale* explaining why it was selected to be in your portfolio and how it meets the criteria which was selected to represent.

**You must also include an opening statement and table of contents describing and outlining (respectively) what is included in your portfolio.

Each of you will meet with me for an individual portfolio review conference. You will provide a *verbal rationale* for the pieces in your portfolio as well as identify your strengths and areas for improvement as an elementary mathematics teacher.

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During the midterm portfolio review conference, the students brought the following pre-established (by me) grading criteria sheet.

Name: _____ Date: _____

***MIDTERM PORTFOLIO REVIEW GRADING CRITERIA (Spring 1995)***

Introduction/Table of Contents

Opening Statement (2 points) _____

Table of Contents (1 point) _____

Developmental Pieces:

Piece #1a /Rationale (6 points) _____

Piece #1b /Rationale (6 points) _____

Representative Piece

Piece #2 / Rationale (6 points) _____

Beliefs/Attitude Piece

Piece #3 / Rationale (6 points) _____

Developmental Practicum Piece

Piece #4 / Rationale (6 points) _____

Representative Practicum Piece

Piece #5 / Rationale (6 points) _____

Strengths/Areas of Improvement

Verbal Rationale Only (1 point) _____

Total _____

***Note on grading rationale. Existence of piece and rationale is worth 1 point. *Quality* of rationale will be graded according to the following criteria.

| | | | | |
|---|---|---|---|---|
| General | | Clear/Specific | | Well Thought Out & Clear |
| Below Average | | Somewhat Reflective | | Outstanding |
| No Example | | One Example | | Multiple Examples |
| 1 | 2 | 3 | 4 | 5 |

In the Fall of 1995, I revised my approach to portfolio assessment. Because of the time required to schedule midterm and final portfolio reviews with over 60 students, I decided to change the midterm portfolio review to be a "peer review." The syllabus now explains:

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**Excerpt from Fall 1995 Syllabus**

**For the Midterm Portfolio** you will provide pieces of your work from the first half of the semester which include:
1) one piece that shows growth/learning about mathematics content
2) one piece that is representative of quality work
3) one piece that reflects your feelings/beliefs about mathematics/teaching mathematics
4) one piece that shows growth/learning about teaching mathematics

**Each of the four pieces should be accompanied by a *typed rationale* explaining why it was selected to be in your portfolio and how it meets the criteria it was selected to represent.

**You must also include a typed table of contents outlining what is included in your portfolio and a typed opening reflection that describes the thinking/learning process you experienced when putting together your midterm portfolio.

At midterm, each of you will meet with a fellow classmate, during class hours, for a "practice" peer portfolio review conference, each 15 minutes in length. During the joint conference, you will each conduct an exhibition of your mini portfolio, explaining what you chose and your *rationale*. You will conclude your session by identifying what you view as your strengths and areas for improvement as an elementary mathematics teacher. Your partner will "score" your portfolio presentation using the rubric provided. You will then write 2 reflections on the portfolio conference process, one on your reaction as the student and one on your reaction as conference observer. You will turn in to me a copy of your opening statement, table of contents, 4 rationales, scored rubric sheet, and 2 reaction reflections. Your midterm portfolio review grade will be based on submission of all required items (**worth a total of 9 points**)

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Each partner evaluates the other's performance on the midterm portfolio conference using the midterm portfolio review grading rubric show on page 6. Subsequently, each student reacts to the portfolio process by responding to the two questions provided on the midterm portfolio reflection sheet shown on page 7.

Student: _____ Date: _____ Conference Observer: _____

***MIDTERM PORTFOLIO REVIEW GRADING RUBRIC***

Introduction

Opening Reflection (2 points) _____

Growth/Learning Content Piece

Rationale (2 points) _____

Representative Piece

Rationale (2 points) _____

Beliefs/Attitude Piece

Rationale (2 points) _____

Growth/Learning Teaching Piece

Rationale (2 points) _____

Completeness

Has all pieces/written rationales/ TofC/
opening reflection ( 2 points)
all or nothing _____

Neatness

Is organized, has section dividers, is typed,
no frayed edges, only minor typos (2 points)
all or nothing _____

Total (out of 14) _____

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**Holistic Grading Rubric for Rationale/Opening Reflection**

0 no rationale; rationale makes no sense; rationale does not relate to the piece selected; rationale is impersonal

1 rationale addresses the piece appropriately but lacks introspection; rationale addresses piece appropriately but lacks clarity; rationale was not well thought-out

2 rationale indicates metacognitive awareness; rationale shows evidence of reflection; rationale clearly justifies/explains the choice of the particular piece

**Midterm Portfolio Reflection Sheet**

***Reflection #1: My reaction as the student in the portfolio process***

***Reflection #2: My reaction as the observer in the portfolio process***

Upon the advise of a colleague who had implemented portfolio assessment many times, I based the final portfolio review around course objectives. Students were to provide evidence that course objectives had been met and again, explain their rationale for each selection. This was a bit problematic for me because I had put together my syllabus, including course objectives, before I had decided to include portfolio assessment in my course. This caused me to reflect upon the quality of my stated course objectives and the extent to which I actually attend to those objectives as the course unfolds. This was only the first instance in which portfolio assessment caused me to rethink how I teach.

### How Portfolio Assessment Affected My Practice

It was clear that if I were to ask students to provide evidence that course objectives had been met, I had to make changes in my teaching. First, as mentioned above, I was forced to reflect on exactly what I really hoped students to gain from my mathematics methods course. I also had to rethink how I structured my course so that students would be provided multiple opportunities to meet those course objectives in ways that they could document. That meant that tasks within the course had to be restructured as well.

In pondering what I thought were the most important goals of my mathematics methods course and what could reasonably be addressed in a semester's time, I settled on the following course objectives:

### COURSE OBJECTIVES (Fall 1995)

1. Preservice elementary teachers will gain a deeper understanding of some mathematical concept or content area;

2. Preservice elementary teachers will be aware of the NCTM Curriculum Standards and how they may be integrated into the teaching of elementary school mathematics;

3. Preservice elementary teachers will change or affirm a mathematics belief by reflecting on and developing their own philosophies of what it means to do, to learn, and to teach mathematics;

4. Preservice elementary teachers will become more knowledgeable of mathematical manipulatives and how they may be used in the learning and teaching of elementary school mathematics;

5. Preservice elementary teachers will gain experience and develop confidence in originating, planning, and implementing mathematics lessons; and

6. Preservice elementary teachers will become more knowledgeable of alternative assessment issues and techniques, particularly those associated with assessing mathematical learning and understanding.

The final portfolio review requirements reflect the objectives and are explained in the following excerpt from the Fall 1995 syllabus:

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**Excerpt From the Fall 1995 Syllabus**

**For the Final Portfolio (18 pts)**, you will provide pieces of your work from throughout the semester which show evidence that you have met the six course objectives stated in the syllabus. Each piece you select must be accompanied by two copies of a *type-written rationale* that explains how the piece you selected exemplifies meeting the stated objective.

The final portfolio should also include two copies of a typed Table of Contents and two copies of a type-written opening reflection in which you discuss (a) what your portfolio contents demonstrate regarding your learning in the course, (b) what you learned about portfolio assessment, and (c) how this portfolio and the portfolio process itself informs/affects you as a future teacher.

During the final portfolio review process, you will conduct the conference session by walking me through your portfolio and explaining how it illustrates your learning in the course by sharing verbal rationale for each piece and discussing your opening reflection. For the final portfolio evaluation, I provide a grading sheet that indicates total points possible per piece. However, together, the class and I will determine the grading rubric by which these points will be awarded.

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In order to encourage students to better document learning from regular class meetings, I found myself providing more explicit means of documentation. For example, each semester, students are shown a series of videos on teaching for understanding via manipualtives. They are also shown videos of problem-solving lessons I have taught out in the public schools. In the past, I merely provided introductory comments before showing the videos. Some students took notes, while others did not. Because of my new sensitivity to documentation, I now provide students with "forms" that they may choose to use as a suggested means of documenting their learning from the video (see pages 10-11). They are not given forms for each video. Rather, they are to decide

how they want to document their learning and make copies of the forms for each video if they prefer, or design their own way of documenting their observations.

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**Example of VIDEO CRITIQUE SHEET**

Video Topic: _____ Date: _____

Notes on Activities in Video:

Notes on Cooperative Learning Observed:

Notes on Teacher Directions/Organization/Questioning:

Notes on Class Environment:

Notes on Students' Interactions/Actions/Motivation/Abilities in Mathematics:

Other Comments:

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## PROBLEM SOLVING & LITERATURE VIDEO CRITIQUE SHEET

Video Topic: _____ Date: _____

Positive Reactions to Video:

Concerns Raised by the Video:

Something that Surprised Me:

Something that Touched Me as a Teacher:

Notes on Teacher Directions/Organization/Questioning:

Notes on Student Actions, Interactions, Motivation:

Other Comments:

In addition to video critique sheets, I provide a suggested means of recording learning from the many problem-solving activities we do in class (see below). I also suggest that students may want to reflect on and record their thoughts about how working as a group on classroom tasks has affected their learning (refer to page 13)

---

**ACTIVITY RECORDING SHEET**

Name: _____ Date: _____

Activity: _____

Mathematics Content Involved: _____

Group Members/Partner: _____

_____

Problem Solving Strategies Involved: _____

Manipulatives/Materials Involved: _____

What I learned as a student:

What I learned as a future teacher:

What I liked most about the activity:

What I liked least about the activity:

**Rating the Activity:**
I would like to use this in my elementary classroom ____yes ____ no ____ unsure
Comments:

The value of this activity is ____ high ____ low ____ medium
Comments:

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## GROUP ACTIVITY RATING SHEET

Group Members: _____ _____

_____ _____

Use the following table, rate the quality of the job you did as a group on each item listed below by checking the appropriate space:

| | Great Job | Fair Job | Poor Job |
|---|---|---|---|
| Everyone participating equally | _____ | _____ | _____ |
| Listening to each other | _____ | _____ | _____ |
| Putting forth our best effort | _____ | _____ | _____ |
| Working as a group | _____ | _____ | _____ |
| Motivating each other | _____ | _____ | _____ |
| Helping each other | _____ | _____ | _____ |
| Sharing ideas | _____ | _____ | _____ |
| Enjoying the activity | _____ | _____ | _____ |
| Completing the activity | _____ | _____ | _____ |
| Understanding the activity | _____ | _____ | _____ |

Explain your rating on two of the above categories:

Did everyone participate in filling out this evaluation form? _____ If not, who did?:

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Another concern raised by portfolio assessment is the evaluation of portfolios. After my first semester of portfolio assessment, I believed that students' portfolio grades were "high," partly due to my inexperience in asking probing questions to elicit quality rationale and partly due to my hesitation to be critical of students' rationale. As I have gained more experience in helping students understand the nature of portfolio assessment, it has become easier for me to "push" students because I am confident that my students are better prepared for the portfolio process. In addition, I am comfortable that portfolio assessment comprises only twenty five percent of students' course grade. I believe it is essential to assess students through a variety of means. Thus, I still give multiple choice/short answer quizzes, I assign class projects, and I require written papers. Through all these means, I believe I am able to better tap into students' learning on a number of levels. Overall, portfolio assessment has forced me to more seriously consider my expectations of students, classroom tasks, and documentation of the learning process.

**Excerpts from Student Portfolios**

Students often surprise me regarding what they choose as evidence of meeting the criteria of the portfolio process. Keep in mind that student choices of pieces cannot be "wrong" as long as they can rationalize their choices. Rationales vary from mediocre to superb. The following are examples of students' opening statements in which they were charged with describing what their portfolio demonstrates.

Erica writes:

> *I think of this portfolio as my own personal learning. It may not be valuable to anyone else, but it is to me. Not only does it organize my learning, but it serves as a reference for me. I cannot possible remember everything I have learned. I can use this to look back as a reminder or to clarify a way to teach math. I have included works in progress, class notes, teacher evaluations, and finished pieces. Each of these things show different levels of growth in my learning. I must be concerned with my continued growth if I hope to be an effective teacher.*

Sally explains:

> *This portfolio includes documents that show how I have learned as a math 394 student. These documents also show how I have transferred that learning into teaching tools as I work on the lessons for the 394 practicum. These documents only pertain to me and to the way ELED 394 class has affected me. I have included these certain pieces because I feel they show how I have grown as a student and how I have progressed toward my goal of becoming a professional educator. I feel that they represent varying facets of how educators teach. The diary piece reflects on how I felt as a student and it lends some information to me on how I must deal with students in order to encourage their joy of learning. The developmental pieces show what I have learned and how beneficial they will be to me as I become an educator. The problem-solving lesson plan shows the kind of work I can do and how I can be creative in my planning. j The last two pieces, the two lesson plans, portray how teaching affects all parties involved. The teacher must be flexible in order for the students to gain the knowledge needed to continue growing and learning. Not only do the children learn, but the teacher finds out that sometimes he/she must be ready to change plans.*

Mae writes:

> *In this portfolio review I feel I show how I have progressed throughout this semester. I feel my attitudes and beliefs have changed for the better. I believe I did a good job representing the quality of preparation and work I have done for my practicum. I also feel more confident about my work. I feel like this portfolio is a good way of organizing and presenting my work. In the future I feel that portfolio review would be a good learning experience for my students.*

Greg says:

> *This portfolio is a testament to the knowledge I have gained thus far in this semester. It is a reflection of what I know, what I have learned, what I need to know and what I can do. It shows the quality work of which I am capable and how I achieved this quality of work. My portfolio is a reflection of my attitudes towards math, before this practicum began, and now that half of it is over. It is a reflection of my teaching styles and lesson planning. Now that I have organized this small sample of information for general inspection and personal reflection I am happy to announce that this portfolio is the best of my work for now.*

The following are examples of writing by students providing their rationale for pieces selected to be a part of their portfolio. Joley writes about the piece she selected to reflect her feelings about mathematics/teaching mathematics:

> *My math diary is a brief reflection of my experiences and why I found math so difficult as a high schooler. I believe that most children like math in elementary school, but lose interest in junior and senior high. This reflection demonstrates and somewhat explains my attitude towards math, and why I didn't want to teach math. However, I have had some time to reflect upon those statements and I now believe that teaching math can be fun, despite bad math experiences in my youth.*

In the next excerpt, Gena provides her rationale for selecting her "process problem solving assignment" as an example of quality work:

> *This piece involves more planning and details than any lesson plan I have done I recent memory, and its success was not easily achieved. I wasn't sure how to approach writing a math lesson, and I spent a lot of time contemplating how to write this one. This lesson is very thorough and detailed. It is the kind of lesson every teacher would love to write if they had the time. My success in writing this lesson is a testament to good lesson writing and the quality of work that of which I am capable to produce.*

Next, Paul explains his rationale for selecting his practicum partner's lesson as a piece that shows learning about mathematics teaching:

> *I selected this piece because it represented one of Sara's best lessons. Sara and I have been partners in practicum before and so I have the added advantage of knowing her work. Know how she teaches, math I this case, I get a sense of what works and what doesn't. I get this sense from the perspective of an observer, not as the observed. I also find out how she writes her lessons and that gives me a perspective into her thinking processes. Getting a different perspective on things helps me to look at my math teaching from that point of view as well. Seeing someone else teach math has helped me learn how to teach math better.*

Finally, Lauren explains why she selected one of her class quizzes as a piece that demonstrates growth in learning:

> *For my second developmental piece, I decided to use one of my quizzes from out class. I feel that this is a piece that exhibits my growth with math because it shows my understanding of this topic. As I stated earlier in this portfolio, math is not a favorite subject of mine. I have to work very hard for my grades, and I was very proud of this quiz. Although I did not receive a perfect score on this quiz, I still believe it is a good indication of growth. Learning is not something that we can perfect. It is a process, and there is always room for improvement.*

## Closing Comments

In closing, portfolio assessment has become an important vehicle through which my mathematics methods students demonstrate their learning. Although the process has not been, or perhaps cannot be, perfected, it provides a forum for the melding of alternative assessment practices. In addition, portfolio assessment encourages self-reflection on the part of the preservice elementary teachers that encourages metacognitive thinking. Finally, portfolio assessment has

forced me, as the course instructor, to be more reflective on my own teaching, which I believe results in a better learning experience for my students.

## References

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